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TRAFFIC AND CIRCULATION PLAN
FOR PROPOSED
TRENTON COMMONS

for

Lee Harris Pomeroy, Architect

New York, New York

by

Wilbur Smith and Associates

New Haven, Connecticut

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CONTENTS

CHAPTER		PAGE
	SUMMARY	
1	INTRODUCTION	
	Purpose and Scope	
	Project Study Area	
2	DATA COLLECTION	
	Sources of Data	
	Field Surveys	
	TOPICS Study	
3	EXISTING TRAFFIC FACILITIES AND EXISTING TRAFFIC OPERATIONS	
	Street Network and Circulation System	
	State Street	
	Other East-West Streets	
	Pavement Widths	
	Barriers to Traffic Flow	
	Present Traffic Operation	
	Direction of Traffic Flow	
	Bus Routes	
	Use of the Street System	
	Average Daily Traffic Volumes	
	Peak-Hour Volumes	
	Traffic Variations and Traffic Growth Trends	
	Evaluation of the Existing Central Business District Street System	
	Volume-Capacity Relationships	
4	PARKING CONDITIONS	
	Existing Parking Activities	
	Off-Street Parking	
	Curb Parking	
	Parking Supply Versus Parking Demand	
	Contemplated Parking Authority Improvements	
	A Parking Overview	
5	FUTURE CONDITIONS IN DOWNTOWN TRENTON	
	Presently Contemplated Development Plans	
	Center-City South Urban Renewal Area	
	Mercer-Jackson Urban Renewal Project	
	John Fitch Way Project	
	Trenton Mall Property	

CONTENTS (Cont.)

CHAPTER		PAGE
5 Cont.	Proposed Street Improvements	
	LaFayette Street Connection	
	Academy Street Extension	
	Future Traffic Volumes	
6	RECOMMENDED CIRCULATION PLANS	
	Objectives of the Circulation Plan	
	Circulation Plan - Phase I	
	Future Traffic Volumes - Phase I	
	Plan Adequacy - Phase I	
	Circulation Plan - Phase II	
	Future Traffic Volumes - Phase II	
	Plan Adequacy - Phase II	
	Cost of the Recommended Circulation Plans	
	One-Way Street Characteristics	
	Operational Characteristics and Circulation	
	Signal Timing	
	Vehicular and Pedestrian Conflicts, Left-Turn Problems and Multi-Turns	
	Efficient Use of Street Widths	
	Capacity	
	Accidents	
	Effect of One-Way Operation on Businesses	
	Other Considerations	
	Transit Rating Considerations	
	Shuttle Bus Operation	
	Evaluation of Traffic Changes	
	APPENDIX	

ILLUSTRATIONS

FIGURE		FOLLOWS PAGE
1	Study Area	
2	Existing Traffic Circulation Pattern	
3	Average Daily Traffic - 1971	
4	Peak-Hour Volumes - 1971	
5	Off-Street and Curb Parking Supply - 1971	
6	Recommended Circulation Plan - Phase I	
7	Anticipated Traffic Volumes - Phase I	
8	Recommended Circulation Plan - Phase II	
9	Anticipated Traffic Volumes - Phase II	

TABULATIONS

TABLE		PAGE
1	Existing Traffic Volumes - 1971	
2	Summary of Volume-Capacity Relationships - 1971	
3	Off-Street Parking Facilities Inventory	
4	Future Traffic Volumes - 1975	
5	Summary of Volume-Capacity Relationships - Phase I	
6	Summary of Volume-Capacity Relationships - Phase II	

SUMMARY

The planned conversion of a portion of State Street from an important east-west traffic route to a major pedestrian oriented facility requires a careful evaluation of traffic circulation and impact on the present street network. The adequacy of the present downtown street network was evaluated and the existing traffic operation of the system was carefully observed.

Traffic circulation patterns for two alternate closings of State Street were tested for adequacy. Existing traffic volume data were obtained for all streets within the study area. These data were then analyzed for peak-hour traffic conditions and projected to account for normal growth and increased development within the Trenton Central Business District. The year 1975 was selected for purposes of evaluating traffic operations.

Under Phase I, an immediate action plan was proposed allowing State Street to be closed from Warren Street to Montgomery Street. Traffic would be diverted from State Street to a one-way loop network by utilizing Hanover Street, one-way westbound, and Front Street, one-way eastbound. Stockton and Montgomery Streets would also be converted to a one-way couplet with Stockton one-way northbound and Montgomery, one-way southbound.

The system would require no major roadway widenings and could be implemented by traffic engineering improvements such as channelization, signs, pavement markings, and signalization.

Phase II considered extending the closing of State Street from Willow to Stockton Streets. Two major modifications in addition to the Phase I circulation improvements would be required:

1. Academy Street would become the major westbound link replacing Hanover Street. This would require the construction of the Academy Street extension between Broad and Warren Streets.

2. Willow Street would be converted to one-way southbound from Hanover to Lafayette Streets.

Implementation of the Phase II plan would be wholly dependent on the completion of the Academy Street extension.

For changes of State Street, anticipated traffic volumes were diverted and distributed over the proposed street system. The capacity of all arterial intersection approaches was analyzed to determine required roadway improvements for traffic operation at an acceptable level of service.

The recommended traffic circulation systems proposed for Phases I and II would achieve a workable traffic solution. Traffic having destinations within the core area would be able to circulate, park and leave the central area without conflict with pedestrian traffic on State Street. In addition, the conversion to one-way streets will greatly simplify signal phasing and significantly increase intersection capacity and safety.

Chapter 1

INTRODUCTION

The central business district of Trenton is the location of the focal point of New Jersey State Government, the hub of Mercer County Government as well as the center of the City Government. The State, County and City agencies comprise the majority of the central area's daytime population and personnel from these agencies are relied upon by the retail community to provide the basis for a revitalized commercial activity.

Like many central business districts in cities throughout the nation, Downtown Trenton has experienced a decline in relative importance as the regional center for its metropolitan area. With the emergence of the regional shopping center and its tremendous convenience to shopper motorists, the Downtown Trenton retail establishments have had to rely heavily on the city's daytime work force for any type of retail success.

The downtown area is now on the verge of a renaissance. The major reason for this new hope is the proposal to turn State Street into a pedestrian-oriented mall. The project, known as the Trenton Commons, would relate closely to the historic past of the city and reestablish State Street as the hub of all retail activities. It is anticipated that the Trenton Commons would stretch along State Street from the Capitol to City Hall and draw its resources from these two major employment centers. This project along with other current renewal work underway in Trenton would be of major importance in returning the central business district of Trenton to regional prominence.

Purpose and Scope

This study concerns itself with the analysis of existing and future traffic conditions, and the development of alternate

circulation concepts to satisfy future land-use developments within the Trenton Central Business District and particularly the Trenton Commons. The purpose of this study is two-fold:

1. To ascertain the present situation concerning traffic circulation in the central business district in order to evaluate present conditions and problems, including past trends;

2. To prepare a conceptual traffic circulation plan which takes into account the removal of all automobile traffic from State Street.

Recommended access and circulation plans were developed based on the ability of the existing plus committed street network to accommodate the increase in traffic resulting from normal growth and additional traffic generated by proposed land-use developements. The future plan for traffic circulation is premised upon the assumption that the development of the Trenton Commons will close State Street to automobile traffic from Willow Street to Stockton Street. This study assumes that such a closing will be achieved and determines the traffic amenities necessary to accommodate such a closing.

During the course of the study, many meetings were held with the project architect, Lee Harris Pomeroy and his staff, and city officials. Close coordination was maintained with the Trenton Planning and Development Department and more specifically with the Divisions of Planning, and Traffic and Transportation. In sum, the recommendations were derived from the joint efforts of a fully inter-disciplinary planning team.

Project Study Area

The Trenton Commons study area, as defined by city and consultant planners at the initiation of the study, is shown in Figure 1. The study area encompasses the heart of the central business district and is bounded by Academy Street on the north,

the Trenton Freeway on the east, Front Street on the south, and Willow Street on the west. For purposes of the circulation plan, traffic operations and accessibility to the project environs were evaluated within this defined area.

Vehicle and pedestrian counts were obtained and plotted, and data relating to traffic flow characteristics on State Street were analyzed. Finally, present bus routes of the Mercer County Improvement Authority were obtained.

Direction of Traffic Flow - The existing circulation in downtown Trenton is presented in Figure 2. One-way operation currently exists on Broad-Warren Streets and Front-Lafayette Streets with a portion of Hanover Street between Warren and Broad Streets also one-way. The remainder of the streets in the central business district presently operate as two-way streets. Figure 2 also shows the location of traffic signals. All major intersections have been signalized.

The traffic signals are all on a fixed-time control and operate on a 70-second cycle length. The traffic signals are not tied to any one central system and lack the flexibility to adapt to various traffic demands at different times of the day. Exclusive or extended left-turn signal indications are generally not employed throughout the central business district with the result that left-turning vehicles cause congestion and delay at several intersections.

Bus Routes - The Trenton Central Business District has good transit service consisting of a system of bus routes radiating in all directions from Downtown. Bus service is provided to the region under the management of the Mercer County Improvement Authority.

Use of the Street System

The relative use and importance of the downtown street system are indicated by the daily and hourly traffic volume patterns. Twenty-four-hour traffic counts were obtained for all streets in the central business district from the Delaware Valley Regional Planning Commission and the New Jersey Department of Transportation. In addition, turning movement counts at all intersections in the study area were obtained from Purcell

Figure 1

Study Area

Chapter 2

DATA COLLECTION

Information relating to traffic, parking, and transit in the Trenton Central Business District was obtained from various sources. In addition, a detailed field reconnaissance of the study area was undertaken by Wilbur Smith and Associates to supplement the data collected.

Sources of Data

The City of Trenton, through the Department of Planning and Development, supplied extensive data obtained through various sources (Appendix, Table A-1). Traffic and transportation data, market surveys, aerial photographs, base maps, as well as information on all planned development concepts including street improvements, currently under consideration in the central business district, were made available. The Department also was in the process of completing or conducting several other studies in the study area, the results of which would be made available when ready.

Data were also obtained from the New Jersey Department of Transportation, the Delaware Valley Regional Planning Commission, and the Mercer County Planning Department concerning present and projected traffic volumes and proposed reqional highway improvements. Since 1960, Wilbur Smith and Associates has been chief consultant to the Trenton Parking Authority. All available statistics pertaining to parking usage and revenues within the study area were readily obtainable. Parking data were also obtained from the Trenton Planning Department and supplemented all Parking Authority data.

Field Surveys

Other than field data gathered by the various agencies, several field reconnaissance trips were undertaken by Wilbur Smith and Associates to evaluate present traffic operations and system deficiencies. Street widths, traffic control devices, quality of travel, and the operation of various parking facilities were observed to determine their impact on central business district traffic.

TOPICS Study

At the time of the study initiation, the City of Trenton had initiated work on its TOPICS program through Purcell Associates of East Orange, New Jersey. Under TOPICS (Traffic Operations Program to Increase Capacity and Safety) cities are eligible for Federal funding to enable them to study and resolve their immediate traffic problems. The program is aimed at achieving implementation of recommended improvements within a relatively short time span and therefore attempts to make use of existing and publicly owned right-of-way to speed the implementation process. The final report is not scheduled for publication until 1972.

Through Purcell Associates, Wilbur Smith and Associates was able to obtain much of the preliminary survey data gathered in connection with the TOPICS study. Average daily traffic volumes as well as peak-hour turning movement counts and pedestrian counts were obtained for all intersections within the study area. Discussions were also held between Purcell and Wilbur Smith and Associates to coordinate activities and avoid any duplication of efforts.

Chapter 3

EXISTING TRAFFIC FACILITIES AND EXISTING TRAFFIC OPERATIONS

The patterns of vehicular and pedestrian movement within the central business district of Trenton reflect the daily activities of the persons living, working, shopping and conducting business within the downtown area. These patterns, when related to the characteristics and capabilities of the existing street network, serve to identify deficiencies and needed improvements. Thus, knowledge of existing operating conditions and traffic controls provides the necessary basis for developing a program of recommendations.

Accordingly, detailed investigations and studies were made of present travel patterns and operating characteristics within the downtown area of Trenton and on the street network serving the central business district area. The pertinent findings and conclusions of these investigations are reviewed in this chapter.

Street Network and Circulation System

The central business district of Trenton is basically served by an east-west, north-south grid network. Major access routes serving Downtown include State Street, which is the only major continuous east-west street, Broad Street and Warren Street. The latter two form a major north-south one-way pair and provide good regional access to both the northern and southern suburbs of Trenton. Other important east-west streets within the study area are Lafayette, Front, Hanover and Academy Streets. Major downtown north-south streets are Willow Street, Montgomery Street, Stockton Street and Armory Drive.

State Street - Historically, State Street has been the major east-west thoroughfare serving Trenton, and today it is the most important central business district street. The intersection of State Street with Broad and Warren Streets is considered the core of all retail activities in the Trenton area.

From Armory Drive to Warren Street, State Street has a varying pavement width (between 32 and 38 feet) with parking allowed only between Armory Drive and Montgomery Street. The pavement type in this area is predominantly brick, providing a glimpse into the historic past of Trenton. All turning movements are prohibited on State Street at its intersection with Broad Street due to the heavy pedestrian movements at these locations. Generally speaking, these heavy pedestrian flows along with the occasional truck loading operations on State Street often restrict and even stop travel on this main east-west thoroughfare. Between Warren and Willow Streets, State Street widens to approximately 40 feet with parking permitted on the south side of the street. West of Willow Street, in the vicinity of the capital area, State Street widens out to approximately 50 feet with parking permitted on both sides of the street.

Other East-West Streets - In the east-west direction, streets in the Trenton Central Business District have virtually nò continuity with many irregular and offset intersection crossings. At the present time, Front Street is the only other major east-west route, other than State Street, continuous from Willow Street to Armory Drive. Front Street is one-way eastbound from Willow Street to Montgomery Street and forms a short couplet with Lafayette Street, which is westbound from Broad Street to Willow Street. At Montgomery Street, Front Street becomes two-way and continues until it becomes Armory Drive. North of State Street, there is no major through east-west street south of Bank Street-Perry Street.

In the north-south direction, streets have fewer discontinuities but there are still irregular and offset intersection crossings. The existing one-way system of Broad-Warren Streets is continuous across the entire length of the central business district. Stockton, Montgomery, and Willow Streets also provide a continuous north-south routing across the downtown area. None of the streets, however, has a uniform cross section throughout the central business district and most have offsets and pavement width changes at several critical points.

Pavement Widths - Pavement widths vary considerably throughout the study area. Warren, Broad, Montgomery, Stockton, State and portions of Lafayette, Front and Hanover Streets all have pavement widths ranging between 36 and 60 feet. The overall discontinuity of the street pattern coupled with the irregular pavement widths on most of the central business district streets, contribute to the serious inadequacies of the downtown street system.

Barriers to Traffic Flow

There are many physical and geographical barriers to vehicular traffic flow in and adjacent to the central business district. The Penn Central Railroad tracks on the south, the Trenton Freeway on the east, and the Delaware River on the west greatly restrict the number of approach routes available to motorists entering the area. As a consequence, traffic entering from the east, south and west is limited to South Broad Street, East State Street, and Perry Street.

Present Traffic Operation

Several studies were undertaken to establish the present level of traffic operations on downtown streets. The direction of traffic flow, number of lanes, location and extent of signals and other traffic control devices and regulations were determined.

FIGURE 2

EXISTING TRAFFIC CIRCULATION PATTERN

Associates. These counts were made during the morning and evening peak hours on all days of the work week. Data were compiled to ascertain average daily traffic, peak-hour traffic, and hourly and daily variations in this traffic.

Average Daily Traffic Volumes - Average weekday traffic volumes for 1971 are presented graphically in Figure 3 and in Table 1. State Street had the highest volumes of any downtown street. Volumes on some sections approach 16,000 vehicles per day. Warren and Broad Streets carried approximately 10,000 and 12,000 vehicles per day respectively. In the east-west direction, other than State Street, Front Street accommodated approximately 7,000 vehicles while Lafayette and Hanover Streets had volumes in the range of 4,000 to 7,000 vehicles per day. In the north-south direction, the largest average daily volumes ranged from 7,000 vehicles on Willow Street to 9,000 vehicles on Stockton Street. Montgomery Street carried average daily volumes of 4,000 vehicles.

Peak-Hour Volumes - Peak-Hour traffic volumes generally occur between 4:00 and 5:30 P.M. on a typical weekday. Figure 4 and Table 1 depict the afternoon peak hour volumes for all streets in the central business district area. The heavy flow of traffic on State Street between Willow Street and Stockton Streets stands out. The heavy flow in northbound traffic on Broad Street and southbound traffic on Warren Street is also indicative of the large amount of traffic passing through the central business district from the north-south direction.

Traffic Variations and Traffic Growth Trends - Traffic data from the count locations in downtown Trenton were used to obtain hourly and daily traffic variations. During the afternoon peak period, 4:30 to 5:30 P.M., hourly traffic constitutes approximately 8.5 per cent of the total daily traffic. This figure represents the maximum hourly traffic flow for any one hourly period and therefore is the most critical time of the day. During the morning peak period between 7:30 A.M. and 8:30 A.M., hourly traffic volumes are nearly six per cent of the daily traffic volumes.

FIGURE 3

AVERAGE DAILY TRAFFIC - 1971

Table 1

EXISTING TRAFFIC VOLUMES
Trenton Central Business District
1971

STREET	LOCATION	AVERAGE ANNUAL DAILY TRAFFIC	PEAK-HOUR VOLUME
State Street	Armory Drive - Stockton Street	12,800	1,100
	Stockton Street - Montgomery Street	15,100	1,000
	Montgomery Street - Broad Street	15,100	980
	Broad Street - Warren Street	15,100	980
	Warren Street - Willow Street	14,300	970
Front Street	Armory Drive - Stockton Street	6,000	540
	Stockton Street - Montgomery Street	7,800	700
	Montgomery Street - Broad Street	6,700	600
	Broad Street - Warren Street	5,700	460
	Warren Street - Peace Street	3,600	420
	Peace Street - Willow Street	2,100	420
Lafayette Street	Broad Street - Warren Street	2,500	230
	Warren Street - Peace Street	4,000	340
	Peace Street - Willow Street	9,500	950
Hanover Street	Stockton Street - Montgomery Street	3,400	300
	Montgomery Street - Broad Street	3,800	350
	Broad Street - Warren Street	2,200	190
	Warren Street - Willow Street	4,200	350
Stockton Street	So. of Front Street	7,300	700
	So. of State Street	7,000	690
	No. of State Street	3,000	270
	No. of Hanover Street	2,800	260

Table 1 (Cont.)

STREET	LOCATION	AVERAGE ANNUAL DAILY TRAFFIC	PEAK-HOUR VOLUME
Montgomery Street	So. of State Street	5,200	470
	No. of State Street	4,700	420
	No. of Hanover Street	4,000	450
	So. of Lafayette Street	12,200	1,070
	So. of Front Street	10,000	840
Broad Street	So. of State Street	9,600	700
	No. of State Street	9,600	700
	No. of Hanover Street	7,200	600
	So. of Lafayette Street	7,200	700
	So. of Front Street	8,000	810
Warren Street	So. of State Street	10,100	820
	No. of State Street	10,000	900
	No. of Hanover Street	8,000	700
	So. of Front Street	5,700	810
Willow Street	So. of State Street	7,100	810
	No. of State Street	7,300	610

The performance of the street system can be evaluated by relating the capacity of individual segments of the street system to the daily traffic volumes actually accommodated. Thus, by comparing imbalances between supply (capacity) and demand (volume) of roadway facilities, it is possible to appraise the street system both in terms of its present condition and its anticipated future condition. Travel speeds and accident records are further indicators of the performance level of the central business district streets.

Volume-Capacity Relationships - Volume-capacity relationships were derived for each of the important signalized intersections in the study area. These analyses were based on present signal timing and available afternoon peak-hour volume counts. They were premised upon criteria set forth in the 1965 Highway Capacity Manual[1] augmented by observations of traffic flow in downtown Trenton.

"Level of Service" is a traffic engineering term which, broadly interpreted, summarizes the different combinations of operating conditions that may occur on a given lane or roadway. Qualitatively, it is a measure of the effect of a number of factors which include speed, travel time, traffic interruptions, freedom to maneuver, safety, driving comfort, convenience and operating costs. For intersection capacity analysis, selected specific levels are found in terms of particular limiting values within some of these factors. When the traffic volumes approach the capacity of a particular intersection, operating conditions are poor, even under ideal roadway or traffic conditions. Drivers will experience significant delays and may have to wait through successive signal cycles. Table 2 presents a summary of these volume-capacity analyses. It includes all intersections

(1) Highway Capacity Manual, 1965, Special Report 87, Highway Research Board, National Academy of Sciences, Publication 1328.

FIGURE 4

PEAK-HOUR TRAFFIC VOLUMES
(4:30-5:30 P.M.)
1971

Table 2

SUMMARY OF VOLUME-CAPACITY RELATIONSHIPS

Existing Conditions

INTERSECTION	APPROACH DIRECTION	VOLUME/CAPACITY (per cent)
Broad-Front Streets	South	51
	West	28
Broad-Hanover Streets	South	74
	East	44
Broad-State Street	South	96
	East	90
	West	73
Front-Montgomery Streets	North	38
	East	21
	West	55
Front-Stockton Streets	North	36
	South	48
	East	16
	West	55
Front-Warren Streets	North	66
	West	68
Hanover-Montgomery Streets	North	36
	South	33
	East	30
	West	27
Hanover-Warren Streets	North	59
	East	33
Hanover-Willow Streets	North	38
	South	35
	East	12
	West	42

Table 2 (Cont.)

INTERSECTION	APPROACH DIRECTION	VOLUME/ CAPACITY (per cent)
Lafayette-Warren Streets	North	68
	East	54
Lafayette-Willow Streets	North	82
	East	34
	West	75
Montgomery-State Streets	North	44
	South	54
	East	57
	West	73
State-Stockton Streets	North	100
	South	43
	East	85
	West	86
State-Warren Streets	North	67
	East	83
	West	92
State-Willow Streets	North	69
	South	32
	East	72
	West	73

within the study area and relates present peak-hour traffic volumes to the practical capacity of each intersection approach.

The most serious capacity deficiencies exist all along State Street from Warren Street to Stockton Street. In general volume-capacity ratios less than 71 per cent indicate that the intersection is operating at better than Level of Service "A". Values between 71 and 76 per cent indicate Level "B"; 77-83 per cent indicate Level "C"; 84-95 per cent indicate Level "D"; and 96-100 per cent indicate Level "E", the ultimate capacity of the intersection approach.

Chapter 4

PARKING CONDITIONS

Parking facilities in the Trenton Central Business District is a vital component among all public facilities serving the downtown area. As such, it must be considered on an equal basis with the major access routes, the downtown arterial streets and the public transportation.

Existing Parking Activities

In order to understand the magnitude of present parking operations within the Trenton Central Business District a complete inventory was made of all curb spaces and off-street parking facilities within the study area. This inventory was compiled by the Department of Planning and Development and supplemented with data obtained by Wilbur Smith and Associates in connection with Trenton Parking Authority work.

Off-street parking - The location and classification of all off-street parking facilities in downtown Trenton are depicted graphically in Figure 5. As of July, 1971, all off-street parking areas were lots operated by the City of Trenton Parking Authority, non-public institutional lots (Government), or privately operated lots and garages. Table 3 presents the breakdown of spaces in each of these categories.

As indicated in Table 3, Parking Authority facilities are relatively small in proportion to the total number of off-street parking spaces located within the central business district. The major bulk of parking activity within Trenton is supplied either by the non-public institutional lots or the privately owned and operated lots and garages.

Table 3

OFF-STREET PARKING INVENTORY
Central Business District
Trenton, New Jersey

PARKING AUTHORITY LOTS

Lot Location	Number of Spaces
Warren and Hanover Streets	500
Merchant Street	300
Lafayette Street	360
TOTAL	1,160

NON-PUBLIC AND INSTITUTIONAL
PARKING FACILITIES

Lot Location	Number of Spaces
Government offices, John Fitch Way, County offices	3,053
Broad and Market Streets	327
Front and Stockton Streets	80
City Hall	104
TOTAL	3,564

Table 3 (Cont.)

PRIVATELY OPERATED PARKING FACILITIES

Parking Lot	Number of Spaces
Sears: Front and Stockton Streets*	597
Holiday Inn: State and Calhoun Streets*	500
Arnold Constable: Front and Montgomery	450
Capitol Parking Lot	135
Nevious Voorhees: 132 East Front Street	65
138 East State Street	135
Trenton Savings Fund Soc.	34
Yen's Parking Lot	50
110 Calhoun Street	33
Willow Parking Company	35
West Hanover Parking	40
Rex Parking Lot	97
Berish Garage	40
Trenton Trust (Willow Street)	32
M.C.C. (Spring Street)	30
Willow and Passaic Streets Lot	80
120 East Hanover Street	180
148 South Clinton Avenue	170
Stacy Garage: 36 West Front Street*	150
413 East State Street	150
Front and Warren Streets	8
Casa Lido	22
Barnes Parking Lot	75
Barney's Auto Park	100
Henderson's Parking Lot	18
Broad Street Bank Lot	28
New Jersey National Bank Lot	37
Moore's Parking Lot	11
Joe's Parking Lot	48
McDermott's Parking Lot	50
Al's Service Station	25
116 East Hanover Street	180
41-43 Chestnut Avenue	200
99 South Clinton Avenue	150
458 Greenwood Avenue	400
TOTAL	4,355

*Multi-Story Garage or Split-Level Lot

FIGURE 5

OFF-STREET AND CURB PARKING SUPPLY

1971

Curb Parking - The location and classification of available curb parking spaces within the study area are also detailed in Figure 5. There are an estimated 1,200 metered spaces in the Trenton Central Business District. The metered spaces include 477 one hour meters and 455 two hour meters.

In addition to the legal spaces for automobiles, a number of special uses were also counted in the central business district. These special use spaces include loading zones for commercial vehicles, bus stops, taxi stands and spaces restricted for use of official cars only.

Parking Supply Versus Parking Demand

Within the core area of downtown Trenton, present parking supply appears adequate to meet current activity levels, with a few notable exceptions. Transient parking (i.e., those parking only a short time--under three or four hours) is gradually declining in total number of vehicles, due in part to elimination of parking generators through urban renewal and other demolitions. In contrast, there has been an increase in commuter parking demand (i.e., all day or monthly) to the extent that restraints or limits have had to be imposed at key facilities in order to maintain an appropriate amount of capacity for the remaining short-term parking. The prospective development of new office complexes in Trenton's Central Business District may reasonably be expected to increase parking demand in a disproportionate manner as related to the total activity generated thereby. It is the old story of one space utilized by only one vehicle all day, versus the same space used by four, five, or even six shoppers.

The present, interim activity of Mercer Community College (MCC) also has a marked effect on current parking demands which, because of its nature, is somewhat difficult to accurately assess.

It can be observed, for example, that on days with good weather, MCC students tend to utilize free or illegal spaces, even if somewhat distant from the College building. However, when bad weather occurs, these students will park in core-area facilities, paying "short-term" charges and, often, preventing the use of these spaces by shoppers and other downtown visitors.

There are two other factors affecting the present situation which may drastically change in the immediate future. There are at least 500, and perhaps as many as 700, "free" off-street spaces on land temporarily vacant within urban renewal projects and elsewhere throughout the central business district. Many of these spaces are occupied all day by MCC students and, interestingly, State employees. With construction of new development and resultant elimination of these spaces, the central business district will encounter an "instant" shortage of off-street parking. Some of this demand will, of course, be removed from the central business district with relocation of MCC.

The other factor pertains to curb parking, of which there is still too much in the Trenton Central Business District. The TOPICS study, now underway, will most likely address this problem in detail, and presumably, the curb spaces to be eliminated will have to be replaced through development of additional off-street facilities.

The foregoing would suggest that, in addition to the on-site parking generation required by new land uses to be developed at both the Mall site and within Center City South, provisions should be made for at least part of the parking activity currently being accommodated by these sites.

Contemplated Parking Authority Improvements

As currently envisioned under the existing Urban Renewal Plan, the Trenton Parking Authority expects to play a key role in development of new, high-capacity, off-street facilities.

At the Mall site, some 1,400 to 1,700 spaces have, at various times, been considered, depending upon alternate site plans and development densities. Within the Center City South Project, structured parking from 900 to as many as 1,500 spaces has been contemplated east of Broad Street, and perhaps an additional 250 to 500 spaces west of Broad Street.

All of the foregoing parking facility plans are entirely contingent upon prior or concurrent implementation of new retail-office-commercial development, with one possible exception. Considerable thought is being given to a "first-phase", partial development of the Center City South garage east of Broad Street, to the extent of approximately 500 spaces.

In addition, preliminary consideration is being given to "doubling" the existing Warren-Hanover Garage from its present 500 space capacity to as much as 900 to 1,000 spaces. An essential component of this project would be the inclusion of the long-desired "Academy Street Extension" between Broad and Warren Streets.

A Parking Overview

The development of modern parking structures to serve new and existing land uses within the Trenton Central Business District does not present a significant problem. The Parking Authority has gone on record many times that they will fulfill their function in or out of Urban Renewal Projects. Essentially, all that is needed to "trigger" parking facility development activity is a clear picture of what is to be built, its firm committment and scheduling, and an expression on the part of the City that it desires the Parking Authority to proceed along a specific course of action.

It should be noted that the ultimate financing of new parking structures is, in effect, a joint venture between the City and the Parking Authority, inasmuch as the latter must be given a City guarantee to render its revenue bonds saleable. While this

is apparently understood by all interested parties, it is of sufficient importance to be pointed out again.

Chapter 5

FUTURE CONDITIONS IN DOWNTOWN TRENTON

After several years of inactivity, the renewal of downtown Trenton is now making gradual progress. In addition to the Trenton Commons, other important development plans are underway in the central business district which are necessary for a total revitalization of the area.

This chapter summarizes those aspects of the plan for the central business district which relate to possible new land uses that would be--or could be-- attracted to downtown Trenton. These land-use alternates, in turn, provide inputs for more precise recommendations for improvements and access and circulation and parking facilities which will be needed to serve the various downtown activities and land uses.

Presently Contemplated Development Plans

Redevelopment concepts currently envisioned in the Trenton Central Business District area are both governmental and private. Plans have already been started on two major urban renewal projects in the central area. They are the Mercer-Jackson Urban Renewal Project and the Center City South Urban Renewal Project. In addition, a third urban renewal project, the John Fitch Way project, is also planned. In the private sector, numerous plans and concepts have been suggested for the still vacant Mall site properties. The most notable work accomplished on this project was by Architect, John Graham, with recent concepts being prepared by the firm of Geddes, Brecher, Qualls and Cunningham.

Center City South Urban Renewal Area - The general land-use plan for the Center City South project consists of the construction and revitalization of retail and office facilities with

necessary parking facilities. The construction of a public park is also within the scope of this project. The project is roughly bounded by East State Street on the north, South Warren Street on the west, East Lafayette and Front Streets on the south and Montgomery Street on the east. The development plans call for the construction of a maximum of 420,000 square feet of commercial space plus a maximum of 80,000 square feet of office space. Public parking would also be established and would probably be in the neighborhood of 1,600 parking spaces.

Mercer-Jackson Urban Renewal Project - The immediate objective of this urban renewal plan is to retain and enhance the existing Mercer-Jackson neighborhood as a downtown residential and commercial area and to promote the health, safety and general welfare of present and future residents and businesses of the area.

The nature and scope of the proposed development will provide a necessary stabilizing element for the central business district through an increase in resident population and will enhance the redevelopment to be undertaken in adjacent urban renewal projects.

The project is roughly triangular in shape and bounded by Front, Market and South Broad Streets. All improvements would be implemented by rehabilitation of present dwellings to eliminate overcrowding and to insure improvements according to desirable standards of safety, health and aesthetics.

John Fitch Way Project - This housing development is roughly bounded by the John Fitch Way, Market Street and the South Warren Street extension. The detailed plans call for 1,063 middle-income apartments in a variety of building types including towers, walk-ups and townhouses situated on 22 acres to be landscaped with sitting areas, play areas, promenades, and plazas.

Trenton Mall Property - In a series of reports prepared for the Trenton Department of Planning and Development, the firm of Gladstone Associates, Economic Consultants from Washington, D.C., analyzed development characteristics for likely land-use development schemes.

The development characteristics for the seven most probable uses for the Trenton Mall site were studied. The land uses were:

1. Office,
2. Residential,
3. Motel/Hotel,
4. Convenience,
5. Shoppers goods retail,
6. Regional retail,
7. Parking.

The land uses were analyzed to determine their likely physical form, densities and their parking implications. For each land use, the likely scale of development based on marketability studies were identified.

According to the Gladstone report, the office complex because of its high compatibility with adjacent public-office functions stands the best probability of implementation. Under this concept, office space of up to 550,000 square feet would be constructed.

Proposed Street Improvements

In relation to future considerations of alternate land uses in downtown Trenton, various roadway improvements have been contemplated. At the present time, two major improvements appear likely:

1) The Lafayette Street extension, and
2) The Academy Street extension.

Lafayette Street Extension - Design plans are being prepared to link the widened portion of Lafayette Street (at Peace Street) to the widened portion of Front Street (at Montgomery Street). The plans call for the construction of a four-lane roadway which will continue along the present Lafayette Street eastward to Broad Street then jog northward and tie-in with Front Street. It is anticipated that Front Street from BroadStreet to Montgomery Street would then be closed or serve only as a major access road to a proposed new parking facility.

First phase implementation of this project would call for initial widening of Lafayette Street from Peace Street to Broad Street. Concurrently, Front Street would be widened from Broad Street to Montgomery Street. At a time when alternate development plans are finalized concerning the Trenton Commons and the Trenton Mall properties, a decision would be made as to whether or not the remaining link should be built.

Academy Street Extension - Dating back to before 1960, considerable thought had been given to the possibility of extending Academy Street west from its present terminus at Broad Street to link up with Hanover Street at Warren Street. This would establish a second major east-west artery and provide considerable traffic relief to State Street. Implementation of this project would require the acquisition of property between Warren and Broad Streets. At the present time no decision has been reached as to when the project would be constructed.

Future Traffic Volumes

Projected 1975 traffic volumes were estimated by assuming normal traffic growth and adding the increment of traffic directly attributable to expected new development in the central business district. Average generation rates, stated in terms of arriving and departing vehicles in the P.M. peak hour, were determined for each

of the major new uses. The generation rates anticipated for future central business district development is depicted in the Appendix (Table A-2).

Within the past few years, traffic growth has decreased slightly in downtown Trenton due to two items: a) the overall decrease of population within Trenton; and b) the decrease of new businesses and commercial activity in the central business district core. However, anticipated traffic growth due to future central business district development is expected to increase by roughly 20 per cent.

Future traffic volume demands (daily and peak-hour) for 1975, assuming no change in the existing street network, are presented in Table 4.

Table 4

FUTURE TRAFFIC VOLUMES
Trenton Central Business District
1975

STREET	LOCATION	AVERAGE ANNUAL DAILY TRAFFIC	PEAK-HOUR VOLUME
State Street	Armory Drive - Stockton Street	15,000	1,300
	Stockton Street - Montgomery Street	18,000	1,200
	Montgomery Street - Broad Street	18,000	1,200
	Broad Street - Warren Street	18,000	1,800
	Warren Street - Willow Street	17,500	1,200
Front Street	Armory Drive - Stockton Street	7,000	650
	Stockton Street - Montgomery Street	9,000	850
	Montgomery Street - Broad Street	8,000	700
	Broad Street - Warren Street	7,000	550
	Warren Street - Peace Street	4,500	500
	Peace Street - Willow Street	2,500	500
Lafayette Street	Broad Street - Warren Street	3,000	300
	Warren Street - Peace Street	5,000	400
	Peace Street - Willow Street	11,000	1,000
Hanover Street	Stockton Street - Montgomery Street	4,000	350
	Montgomery Street - Broad Street	4,500	400
	Warren Street - Willow Street	5,000	400
Stockton Street	So. of State Street	6,000	800
	No. of State Street	3,500	300
Montgomery Street	So. of State Street	6,000	550
	No. of State Street	6,000	550
Broad Street	So. of State Street	11,000	850
	No. of State Street	11,000	850
Warren Street	So. of State Street	12,000	1,000
	No. of State Street	12,000	1,000

Table 4 (Cont.)

STREET	LOCATION	AVERAGE ANNUAL DAILY TRAFFIC	PEAK-HOUR VOLUME
Willow Street	So. of State Street	8,500	950
	No. of State Street	8,500	950

Chapter 6

RECOMMENDED CIRCULATION PLANS

The land-use and proposed development plans underway in downtown Trenton are instrumental in the revitalization of Trenton. However, any improvements in the retail, residential, and office sectors of the downtown area will necessitate a study of traffic implications including adequacy of access routes as well as internal circulation and parking facilities in the central area. The primary goal of the recommended circulation plan, therefore, is to provide improvements that will enable downtown Trenton to compete successfully with outlying regional shopping centers and reinforce its position as the principal commercial, governmental, cultural and entertainment center in the region.

In sum, the proposed land-use projections made for the central business district, notably the development of the Trenton Commons, are based on the premise that required improvements in traffic, access and parking facilities will be underway in the foreseeable future. Without such improvement, the decline of downtown Trenton can be expected to continue.

Objectives of the Circulation Plan

In meeting the goals of improved circulation within downtown Trenton a number of specific planning objectives can be stated as follows:

1. Develop a suitable traffic routing plan which would successfully accommodate the traffic volumes diverted from State Street;

2. Improve the quality of the environment along State Street for pedestrians by minimizing pedestrian-vehicular conflicts;

3. Provide more continuity and greater simplicity in the street system;

4. The implementation of a "belt" or "loop" system that circumscribes the central business district core (State Street) and improves accessibility to and from major existing and proposed traffic generators;

5. Modernize the local street system to facilitate upgraded land use and block spacing arrangements and thereby give impetus to the proposed new development in downtown;

6. Restrict or prohibit curb parking on critical sections of the street system to increase traffic capacity and safety;

7. Provide flexibility so that the plan can be efficiently implemented in stages.

The recommended street plan for the central business district of Trenton fully meets the objectives as set forth above. The plan is the culmination of many discussions with city officials as well as a number of interested individuals and groups representing the CBD. To a large degree, the plan builds on previous proposals put forth for downtown circulation. The recommended circulation plan consists of two parts: (a) Phase I, scheduled for immediate implementation; and (b) Phase II, proposed for implementation in 1975 or later.

Circulation Plan - Phase I

The recommended circulation plan is based upon an idealized conceptual plan for access and circulation, which achieves separation of pedestrian and vehicular traffic by a "loop-bypass" network, and provides for improved circulation in the central business district core. The recommended circulation plan for Phase I is presented in Figure 6.

Phase I is an immediate action plan in which State Street is to be closed from Warren Street to Montgomery Street. Traffic would be diverted from State Street to a one-way loop network utilizing Hanover Street one-way westbound and Front Street one-way eastbound along their entire lengths. Stockton Street and Armory Drive would be converted to one-way northbound routes while Montgomery Street would be converted to one-way southbound from Hanover Street to State Street. Between State and Front Streets, Montgomery Street has sufficient pavement width to remain as a two-way facility, primarily serving as a feeder street into the parking lots located along the east side of the street.

The implementation of the Phase I plan presents one major difficulty in connection with the existing southbound ramp from the Trenton Freeway onto Front Street. The location and configuration of this southbound ramp is most undesirable--too close to the Market Street interchange, (approximately 200 feet) and sub-standard design creates unsafe traffic conditions for vehicles on Front Street. Implementation of the one-way system on Front Street makes it desirable to close this ramp altogether. However, the Phase I circulation plan could be adapted to allow traffic to exit from the ramp and proceed west on Front Street to Stockton Street at which point all traffic would be forced to turn northward. For this

Figure 6

RECOMMENDED TRAFFIC CIRCULATION PLAN

Phase I

adaptation, Front Street would of course be a two-way street between Stockton Street and Armory Drive. Further engineering studies would have to be initiated to determine the feasibility of closing this ramp.

The Phase I circulation plan would require no major roadway widenings and could be implemented by relatively inexpensive traffic operational improvements. The plan includes the implementation of the proposed one-way street concept, various curb parking prohibitions and restrictions, a program of pavement marking and signing, and some modifications to the signal system.

The prohibition of "curb parking" requires considerably more than the removal of curb meters and prohibition of "ordinary" auto parking. It also means a severe curtailment of other curbside functions, particularly loading zones, during normal peak hours and certain other portions of the business day. The reason for this is simple: the parking lane is needed for traffic movement and, accordingly, its function as a storage or terminal lane can no longer be accepted.

Unfortunately, while the elimination of curb parking is relatively easy, the elimination of other curbside functions, becomes more difficult. Many businesses must utilize curb loading areas as their sole source of truck-service access. In these cases, complete prohibition is not practical. This is particularly evident on Hanover Street between Warren and Broad. Conversely, many loading zones were established years ago and no longer are truly needed and can be readily eliminated.(1) In a few cases, commercial leases are "tied" to contiguous loading zones, the elimination of which would cause obvious problems.

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(1) Consideration might be given to a new "loading-zone" ordinance, under which all loading zones must be re-licensed at two-year intervals. This might assist in eliminating those which have long-since outlived their usefulness--many of which are, in fact, used for other purposes. Time restrictions on use of these zones provides another avenue toward maximum utilization of the curb lane.

Future Traffic Volumes - Phase I

In order to evaluate the Phase I circulation plan and to insure its adequacy through Phase II implementation, future traffic volumes were estimated and projected to the design year. The year 1975 was arbitrarily selected as the design year for Phase II.

Traffic volumes for 1975 were manually assigned to the Phase I network by allocating traffic to the most logical routes. This procedure involved a diversion of existing traffic off of State Street and onto the remaining street system. After the diversion, future estimated volumes resulting from normal growth, were added to that traffic. The anticipated 1975 P.M. peak-hour volumes for the Phase I circulation plan are shown in Figure 7.

Plan Adequacy - Phase I

The anticipated future traffic volumes, assigned to the Phase I network, were then tested for adequacy according to techniques set forth in the Highway Capacity Manual.[2] Table 5 presents a summary of the volume/capacity relationships that will exist at all major signalized intersections within the study area.

As previously discussed, traffic capacity is measured in terms of levels of service which reflect overall conditions of both the street and traffic stream. With the conversion of the present street system to a one-way system, the efficiency of the network

(2) Highway Capacity Manual, 1965, Highway Research Board, Special Report 87.

Table 5

SUMMARY OF VOLUME-CAPACITY ANALYSES

Phase I-1975

INTERSECTION	APPROACH DIRECTION	VOLUME/ CAPACITY (1) (per cent)
Broad-Front	South	53
	West	67
Broad-Hanover	South	38
	East	39
Front-Montgomery	North	34
	West	54
Front-Stockton	South	50
	West	60
Front-Warren	North	78
	West	73
Hanover-Montgomery	North	48
	East	31
Hanover-Warren	North	60
	East	50
Hanover-Willow	North	54
	South	42
	East	11
	West	62
LaFayette-Warren	North	50
	East	26
LaFayette-Willow	North	83
	East	37
	West	82
Montgomery-State	North	20
	South	10
	East	22

Table 5 (Cont.)

INTERSECTION	APPROACH DIRECTION	VOLUME/CAPACITY (1) (per cent)
State-Stockton	South	60
	East	49
State-Warren	North	71
	West	80
State-Willow	North	83
	South	25
	East	55
	West	77

(1) Capacity at level of service "E".

Figure 7

ANTICIPATED TRAFFIC VOLUMES

Peak Highway Hour

(4:30-5:30 P.M.)

Phase I

is significantly increased. This is basically due to the simplification of signals and signal phasing and also the separation of the heavy pedestrian volumes on State Street from the vehicular traffic.

The volume-capacity relationships depicted in Table 5, indicate all signalized intersections in the Phase I plan should have sufficient capacity reserves in the design year. The most critical intersections will be Warren and State Streets and Warren and Front Streets with volume/capacity ratios of .80 and .78, respectively.

Circulation Plan - Phase II

Depending upon the initial success of the Trenton Commons in Phase I, additional closings of State Street are proposed to be implemented in effort to expand the project. Under Phase II, it is anticipated that State Street would be closed to automobile traffic from Stockton Street to Willow Street. The recommended circulation plan for Phase II is presented in Figure 8.

Implementation of an efficient traffic circulation plan to handle the Phase II closings is dependent primarily on one major roadway improvement, the Academy Street extension. As discussed in an earlier chapter, Academy Street would be extended through the block north of the Warren-Hanover parking garage and link up with West Hanover Street. This would be extremely essential to the Phase II circulation network in that the one-way loop network proposed under Phase I could now be achieved under Phase II. The Phase II system would require the following major changes from the Phase I system:

FIGURE 8

RECOMMENDED CIRCULATION PLAN

Phase II

1. The conversion of Academy Street to one-way westbound from Stockton Street to Willow Street;

2. The conversion of Willow Street to one-way southbound from Hanover Street to Lafayette Street;

3. The re-conversion of East Hanover Street back to two-way operation from Broad Street to Stockton Street.

Under the Phase II circulation plan, major construction would be needed for the Academy Street extension. The implementation of all other improvements would be achieved, as in Phase I, by pavement striping, signing, signalization, and channelization. Some radius adjustments at various intersections and the elimination of curb parking at some locations would also be required.

Future Traffic Volumes - Phase II

Traffic volumes for the Phase II network were evaluated for 1975 and are depicted in Figure 9. The traffic volumes on this system differ from the Phase I system chiefly in that volumes are considerably higher on Front Street, west of Warren Street.

Plan Adequacy - Phase II

The recommended circulation network for Phase II was tested for adequacy based on the Phase II anticipated volumes. The results are summarized in Table 6.

According to the volume/capacity relationships depicted in Table 6, all tested intersections achieved acceptable levels below the practical capacity of the intersection.

FIGURE 9

ANTICIPATED TRAFFIC VOLUMES
Phase II

Table 6

SUMMARY OF VOLUME-CAPACITY RELATIONSHIPS

Phase II

INTERSECTION	APPROACH DIRECTION	VOLUME/ CAPACITY (per cent)
Broad-Front	South	53
	West	67
Broad-Hanover	South	36
	East	23
Broad-Academy	South	45
	East	40
Front-Montgomery	North	34
	West	54
Front-Stockton	South	50
	West	60
Front-Warren	North	55
	West	80
Hanover-Montgomery	West	32
	East	42
	North	52
Hanover-Warren	North	50
	East	20
Hanover-Stockton	West	36
	South	60
Hanover-Willow	North	36
	East	40
	West	25
Lafayette- Warren	North	48
	East	26
Lafayette-Willow	North	83
	East	37
	West	82

Table 6 (Cont.)

INTERSECTION	APPROACH DIRECTION	VOLUME/ CAPACITY (per cent)
Montgomery-Academy	North	28
	East	36
State-Stockton	South	34
	East	49
State-Willow	North	80
	West	85
Warren-Academy	North	40
	East	38

Cost of the Recommended Circulation Plans

The costs for implementing the recommended circulation plans were estimated to be $50,000 and $125,000 for Phases I and II, respectively. These costs are based on 1971 unit prices and include such items as signal upgrading, new signal installations, signing, pavement markings, minor channelization, and roadworks; not included in these costs are signal interconnection, demolition costs, and right-of-way costs.

It is anticipated, a major portion of these costs could qualify for TOPICS type improvement costs. This is apparent due to the nature of the recommended improvements--traffic engineering improvements designed to increase capacity and safety on existing streets.

More specific improvements included in the above cost estimates are as follows:

Traffic Signals
- -new installation (excluding interconnection)
- -upgrading presently signalized intersection

Signs
- -parking signs
- -stop signs
- -others

Markings
- -pavement lane markings
- -stop lines
- -pavement turn markings

Channelization
- -minor raised and painted channelization at several high turning volume intersections

Roadways
- -Academy Street extension between North Broad and North Warren Streets (excluding demolition and right-of-way acquisition).

One-Way Street Characteristics

Some of the major characteristics of one-way street operation include improved traffic operations, minimized pedestrian-vehicular conflicts, accident reduction, and their effect on businesses. The following sections describe these characteristics in further detail. (2)

Operational Characteristics and Circulation - Unidirectional flow simplifies and organizes trafic better and results in greatly improved operational characteristics for an one-way system, allowing this system to collect and distribute traffic more efficiently. A street should accept traffic from other streets easily and should distribute that traffic to desired destinations including other streets, curb or off-street parking areas, and through curb cuts, to other auto-oriented uses such as drive-ins and service stations. In urban areas, even on crosstown one-way arterials, very little of the traffic is of the "through" type.

Two-way streets have difficulty in distributing traffic, primarily because much of the traffic desires to turn left in the face of the opposing flow which has the right-of-way. Also, parking spaces on the left of a two-way street cannot be reached, and on divided raodways curb access points on the left are not accessible.

On the other hand, one-way streets distribute their traffic to the left or right with equal ease. Parking spaces and curb access in both sides are open to all motorists. Businessmen often resist one-way operation because they fear the effect of having only one-half of the traffic passing their doors. Yet, it is easy to demonstrate that if motorists are properly directed through public and private announcements, and when motorists have developed experience with a one-way arterial system business men will receive the benefits of the better and safer mobility and access developed by a pair of one-way streets.

Signal Timing - In modern street operation, a great deal of emphasis is placed on a smooth flow of traffic controlled by traffic

(2) Source: "Improved Street Utilization Through Traffic Engineering", Highway Research Board, Special Report 93, 1967.

signals. The most efficient, the most accident free, and the most pleasurable to drive arterial system is the one which maintains a reasonably constant and uniform speed throughout. Stop-and-start driving destroys all three of these attributes.

Two-way streets can provide this desirable smooth flow, if proper spacing of traffic signals can be maintained. All too often, however, signals are required at spacings too close to permit timing that affords smooth flow in both directions. Compromises must be made in the delicate time-distance relationship which governs speed, and the result is a loss of the desired uniform travel speed.

To solve the left-turn circulation problems of two-way arterials, invariably many added left-turn signal phases are installed. These added phases further complicate signal-timing procedures and further restrict the traffic engineer's ability to provide smooth progressive signal timing and flow. Acute signal-timing problems brought about by adverse spacing and multi-phase operation can nearly ruin an otherwise well-designed two-way street.

On an one-way street system there is much less difficulty in obtaining uniform flow and better efficiency because the spacing of signals is no longer a major factor, and the adding of special phases is seldom required. A smooth progression can be provided even with traffic signals every block, such as along a business one-way street or through a grid.

Vehicular and Pedestrian Conflicts, Left-Turn Problems and Multi-Turns - One indication of the accident potential of an intersection is the number of vehicular conflicts. Comparing the intersection of two 4-lane, two-way streets with two 4-lane, one-way streets, the two-way streets generate 44 possible vehicular conflicts, whereas the one-way streets have only 18 conflict points. This reduction is a major advantage.

Because they cross opposing traffic lanes, left-turn movements on a two-way street cause many points of conflict; therefore, the left-turn movement requires expert motorist judgement unless a special signal phase is provided so that the turn can be made without opposing traffic. Difficulty with left turns from two-way streets is very

apparent because of the great number of requests from motorists for left-turn signal phases and the many high-accident locations recorded where left turns are the basic cause.

Left turns from two-way arterials, unless provided with separate left-turn storage lanes, or prohibited entirely, also cause major delays to through lane traffic. Through-motorists irritation leads to unsafe driving practices, such as lane changing and speed limit violations involving motorists trying to catch up with the normal flow set by the signal timing.

One-way streets solve the left-turn problem inherent on two-way streets and even allow a multi-turn design which is difficult to install in two-way operation. Multi-turns in one-way flows must be carefully considered, however, as double turns from a one-way street are a problem if pedestrian volumes in the conflicting crosswalk are moderate to heavy and special WALK phases are not provided. Many cities, however, have utilized double right and left turns along one-way systems successfully for many years.

Efficient Use of Street Widths - In two-way street design, many streets in areas where congestion occurs have relatively fixed roadway widths and their dimensions do not lend themselves to two equal and usable half-widths for opposing traffic flows. For example, assuming no parking a street of 34 feet in roadway width with two-way operation is only suitable for two-lane design. In one-way operation, three lanes can be fitted to a 34 foot pavement with an increase in capacity. The same principle applies to other widths which provide an odd number of lanes. More efficient use of existing pavement widths can often be made by designing all lanes in one direction.

Capacity - It has been noted that one-way systems provide better capacity potential because of better operational characteristics better signal timing, fewer vehicular and pedestrian conflicts, the elimination of the left-turn problem, provision of multi-turn possibilities, and more efficient use of certain street widths. Many references indicate that one-ways improve capacity under various conditions from 25 to 50 per cent or more over comparable two-way arterials. This, of course, is a great boon to those responsible for traffic movement in a community. Capacity improvements lead to many one-way street developments as an alternative procedure to expensive two-way

street widening projects.

At this point it should be emphasized that the 1965 Highway Capacity Manual cautions that the subject of relative efficiencies and capacities of one-way and two-way urban streets has solicited much discussion in recent years. Although early criteria showed substantial benefits in one-way over two-way operation, later interim intersection capacity criteria of the late 1950's showed somewhat contradictory relationships, largely because upgraded one-way systems were being compared with lane efficient, unimproved two-way systems. However, the Highway Capacity Manual does concur that one-way traffic flow is more efficient and generally is highly desirable.

Accidents - There are no national statistics concerning the number of accidents on two-way streets versus one-way street, but there are many indications from cities across the country that accident totals drop after conversion to one-way operation. Reports such as a 23 per cent drop in total accidents, and a 62 per cent drop in pedestrian accidents in Sacramento, California; 51 per cent in Hollywood, Florida; 50 per cent in Raleigh, North Carolina; 28 per cent in Modesto, California; and 50 per cent in Portland, Oregon, support the conclusion that accident frequency will be reduced with a properly engineered one-way system.

From the pedestrian standpoint, the one-way street is also much safer. Pedestrians need only look one direction for vehicular traffic. The platooning of traffic on a one-way street is usually very evident, thus making it quite easy for pedestrians to cross safely during well-defined gaps in flow. One-way street intersections have at least one and sometimes two protected crosswalks where no vehicular turns are made. From the signal-timing standpoint, pedestrians are also aided as excessively long cycles are usually avoided where one-way streets are used. Long cycles cause waiting periods beyond the tolerance of pedestrians, a condition which discourages voluntary observance of traffic controls by pedestrians.

In comparison, two-way arterials are much more difficult for pedestrians to cross because of the basic problems inherent

in two-way traffic, e.g., pedestrians must continually look both ways for approaching traffic, adequate gaps in traffic are much less frequent and the number of conflicts in intersection crosswalks is much greater.

Effect of One-Way Operation on Businesses - In the past, the great majority of businessmen have not favored one-way streets; many still do not. However, in cities today where one-way streets are frequently used as access arterials and CBD grids, disfavor is now at a minimum, as most businessmen realize that business activity is enhanced by the benefits of a properly designed one-way system.

A study conducted in Denver, Colorado, in 1964 summarized all available information on the economic effects on one-way streets on businesses. Included were a detailed study of 16th Street in Sacramento, California; a survey by the U.S. Chamber of Commerce; and a survey by Fresno, California. Without excessive detail, it can be said that business on one-way 16th Street in Sacramento increased nearly 5 per cent, more than business on the other streets in the city: The Chamber of Commerce survey showed that businessmen in 103 out of 134 cities were in favor of one-way operation after a fair trial. The Fresno survey of Merchants Association indicated that 90 per cent of the businessmen felt that one-way streets were not harmful to business, and 85 per cent would recommend them.

Certainly, some types of businesses may be harmed, although probably only temporarily, by loss of traffic in a certain direction. These are primarily drive-in facilities which previously catered only to the direction of traffic which was eliminated. On the other hand, many other businesses will certainly increase their trade through the improved accessibility of one-way street systems.

Other Considerations - There are a few minor disadvantages concerning one-way street flow. These can be summarized as follows: one-way streets may necessitate additional travel for some motorists; tourists may become confused with the system, one-way traffic streets may require additional sign posting, emergency vehicles may have more difficulty moving on a one-way street than a comparable two-way arterial, transit riding habits may be adversely affected, especially if the distance between the one-way streets is great; added turns along a one-way system may increase pedestrian conflicts unless

separate signal WALK phases are provided; and in a one-way grid or arterial system progressive signal timing may work to the disadvantage of circulating traffic as a block-circulating motorist generally will have to stop for a red signal at each successive intersection.

The disadvantages, however, are greatly offset by benefits of one-way flow. A New York City Department of Traffic publication, "Questions and Answers About One-Way Avenues," points out that one-way street operation reduces delays in bus movements caused by congestion, thus, giving riders a more enjoyable trip in a smoother flow of traffic. Also, bus patrons have shorter waits for buses since buses are less subject to the "bunching up" which occurs in congestion.

The New York report also notes that one-way street flows reduce air pollution from motor vehicles because of a reduction in stops and periods of acceleration and deceleration.

Transit Routing Considerations

The closing of State Street to traffic effects not only automobile traffic but also public transit buses. Current east-west bus routes are all routed on State Street in the downtown area. Upon implementation of Phase I or Phase II, all buses would most likely be diverted to the "loop bypass" network. The present scope of work did not concern itself with a detailed rerouting of transit facilities within the central business district area. However, in evaluating the network efficiency, consideration was given to alternate bus routings, particularly their effect on intersection capacity. Further analyses will be needed to resolve details on bus circulation with respect to routings, location of bus stops, convenience to State Street and other pertinent usage characteristics.

Shuttle Bus Operation - Throughout discussions on the Trenton Commons, considerable support was expressed to some type

of transit system which could still operate on State Street and make the Trenton Commons readily accessible from both the Capitol and City Hall areas. Shuttle bus systems in operation in other cities of comparable size, were investigated.

In order for a shuttle bus operation to be successful it would have to be available to patrons at relatively short headways and at convenient locations. Generally speaking any headway greater than five minutes would not be convenient and would tend to discourage ridership.

Within the downtown area two types of shuttle bus operation appear operable:

1. An east-west route principally serving shoppers and businessmen during the lunch period (11:00 A.M. - 2:00 P.M.) traversing State Street between the two major employment complexes;
2. A north-south route linking the major residential and parking areas with State Street.

If such a system were implemented, important decisions relating to schedules, routes and financing of the operation would be required.

Evaluation of Traffic Changes

As traffic improvements are implemented, the City of Trenton should make careful evaluations of the level of retail business. In making such studies, however, it is of utmost importance to relate the apparent effects on business activity, that may appear, to a general index of economic activity in downtown Trenton. Before a change in traffic operations can be credited

with having either favorable or adverse effects on business activity, the bias introduced by other outside influences must be carefully eliminated.

APPENDIX

Table A-1

Project Inputs

1. "Comprehensive Planning Program," Transportation Plan Traffic Analysis, 1969; Mercer County Planning Board, Mercer County, New Jersey.

2. District Highway Network, Coverage Traffic Counts; Delaware Valley Regional Planning Commission.

3. Peak-Hour Traffic Volumes, Selected Downtown Intersections; Purcell Associates.

4. "Phase II Report, Trenton Mall Property", 1971; Gladstone Associates, Economic Consultants, Washington, D.C.

5. "Parking Survey for the City of Trenton Central Business District", 1971; Trenton Planning Department.

6. "Survey of State Parking in Downtown Trenton," March, 1970; The Division of State and Regional Planning.

7. "Urban Renewal Plan, Mercer-Jackson Urban Renewal Project, N.J.R.-142"; Department of Planning and Development, Division of Planning.

8. "Urban Renewal Plan, Center City South Urban Renewal Project, 1970; Department of Planning and Development, Division of Planning.

9. "Survey of Trenton Bus Rider Characteristics and Travel Patterns", 1970; Department of Planning and Development, Division of Planning.

10. "Annual Reports, Parking Authority of the City of Trenton, New Jersey"; Wilbur Smith and Associates.

APPENDIX

Table A-2

Economic Effects of One-Way Streets

Following below are excerpts from a publication dealing with one-way business streets, published by the Chamber of Commerce of the United States:[1]

"HOW DO BUSINESSMEN REGARD ONE-WAY STREETS?"

Businessmen generally oppose the conversion to one-way movement in front of their places of business. However, such opposition usually disappears after the one-way rule has been adopted and given a trial period.

These conclusions are based on a special survey made by the Chamber of Commerce of the United States and covering 134 communities where business district streets had been converted to one-way operation.

In 90 cities, businessmen were against the idea, but such opposition disappeared in 62 of these cities after a trial period. In three cases there was no opposition until after the one-way was installed. In 41 cases no opposition existed either before or after.

All but nine of the one-way plans were retained. In these nine cases, all or part of the system was changed back to two-way operation due to opposition of affected businessmen.

The following are typical statements from the Chamber Survey:

Charleston, South Carolina (Pop. 70,000), Chamber of Commerce... Businessmen and citizens are now pretty well sold on the one-way system of streets for the entire urban district and would oppose any return to the confusion and congestion of the old two-way system.

(1) "One-Way Business Streets" Chamber of Commerce of the United States, Washington 6, D.C., July, 1954.

Cairo, Illinois (Pop. 14,700), Association of Commerce, Inc.,... Our one-way streets in Cairo have brought about less congestion with regard to parking and simplified the pedestrian hazard in crossing the streets involved...The one-way street idea has proved so successful here in Cairo that the Traffic Committee is in the process of making plans for a greater number of one-way streets in our business district.

Charleston, West Virginia (Pop. 74,600), Chamber of Commerce... The system has improved movement of traffic in the central business district of Charleston at least 50 per cent or more... there were numerous complaints by businessmen that such a system would "ruin" their business or seriously hurt it. There is still a comparatively small degree of such sentiment at a few points. But our committee has not the slightest evidence of an authoritative or reliable nature that any specific business has been seriously hurt by the establishment of the one-way system...It is the firm conviction of the writer that the continued opposition of a few businessmen to one-way traffic movement after it has been installed and accepted over a period of years is still based largely upon "preconceived notions" and "imagined disadvantages."

Greater Hazleton, Pennsylvania (Pop. 35,100), Chamber of Commerce... The attitude toward one-way streets was not favorable before they were installed but this resentment has now turned into high praise, and additional one-way streets are being considered.

Hagerstown, Maryland (Pop. 39,600), Retailers Bureau...Not without considerable apprehension on the part of many retailers and citizens alike was the system of one-way streets inaugurated...It is interesting to note, however, that toward the end of the trial period no one had requested the city government to discontinue one-way streets...our principal retailers were polled as to their reaction today to our one-way streets. The consensus of their views: (1) there has been a great improvement in the movement of vehicular traffic; (2) no customer complaints are being received; (3) more miles are consumed in making deliveries, but this is more than compensated by a savings in time; (4) under present conditions the retailers are opposed to the elimination of one-way streets.

McAllen, Texas (Pop. 25,600), Chamber of Commerce...Prior to instituting one-way business streets in McAllen, some of the merchants were fearful that it would damage their business, but I have not heard of a single complaint. In fact, the businessmen believe that it has assisted business because it relieves congestion.

Businessmen point out that parking is still permitted on the one-way streets and that customers are less irritated because the long lines of snarled traffic have been relieved.

Greater Muskegon, Michigan (Pop. 49,400), Chamber of Commerce... There was a strong objection...But within three or four months this had died down and one-way thoroughfares became a fixture... About two years ago two other cross streets were similarly designated...Again, we had violent objection, particularly from some parking lot operators and again the public has adjusted itself... Several of those who opposed originally continue dissatisfied and say the program hurts business. However, they have no figures to substantiate it and admit that it is largely a matter of opinion and prejudice. They admit, however, that factory workers in our big downtown plants get home quicker, i.e., traffic is expedited.

San Diego, California (Pop. 467,100), Chamber of Commerce...There was a small but very vocal opposition to the installation of the two one-way streets we now have...Most of the merchants now have adjusted themselves to the streets, accept them, do not complain about them, and would probably resist their reverting to two-way streets.

Toledo, Ohio (Pop. 316,000), Chamber of Commerce...Our initial one-way street system was instituted with approval of the great majority of business people. A few, of course, maintained that it would have an adverse effect upon business. After several months of operation this feeling was dispelled and additional streets were included under the one-way grid system in the central business district and outlying sections.

"HOW DO ONE-WAY STREETS AFFECT RETAIL SALES AND PROPERTY VALUES?"

There has been little research as to the effect, if any, on retail sales and property values when one-way movement is instituted. However, all findings point toward the conclusion that overall business activity is enhanced and there is general agreement by businessmen on this point.

A study in the City of Sacramento (Pop. 158,747) by the California Division of Highways before and after 16th Street was made one-way, proved that retail business on this street increased 26.7 per cent, a five per cent greater increase than the average throughout the area. Two years were compared, beginning July, 1949, and ending in June, 1951. Corner locations, doing the greatest volume of business, increased 5.2 per cent more than the average. Inside locations were 3.7 per cent above average. Sales tax returns provided the facts for this retail business study.

The Washington State Highway Commission reports that after one-way streets were adopted in Olympia (Pop. 16,800), although business in general continued on a downward trend, business on the one-way couplet showed an increase. During the first year of the

system's operation, the total sales volumes along the one-way streets was 101.8 per cent of the preceding year, while the level on other non-one-way streets showed a slump to 98.7 per cent.

Comparisons of property sales in the Sacramento example (see previous page) during the year before and the year after the change indicated no difference between values on 12th Street and in other parts of the city not on one-way streets.

City Traffic Engineer, D. Jackson Faustman, of Sacramento questioned 53 cities in 1949 in an effort to learn what effect one-way movement had on property values. Two cities report an increase in assessed valuation of abutting property and one a decrease. However, 39 reported no change.

Typical comment obtained in the U.S. Chamber survey follows:

Corvallis, Oregon (Pop. 18,000) Chamber of Commerce...It is the general opinion that one-way streets are not damaging to business and that free-flowing traffic actually has stepped up and stimulated sales...It is certain that assessed valuations and property costs have not been decreased and total retail sales in the community have been on a constant increase year after year since 1939.

Detroit, Michigan (Pop. 1,925,200) Retail Merchants Association...The increased traffic volume has meant greater sales and consequently increased property values in the downtown area. In no case was anyone forced out of business and in the majority of instances, the merchant found that he benefited from the increase in traffic capacity.

Los Angeles, California (Pop. 2,104,900) Chamber of Commerce...Following the installation of one-way streets in the downtown area, the businessmen realized that this operation was not as detrimental as was expected. They further realized that it did not hinder their competitive efforts with other merchants in the same area, nor did their sales drop below normal. The Downtown Businessmen's Association in Los Angeles did a remarkable job in the education of these merchants toward this necessary traffic device...Fifth and Sixth Streets in downtown Los Angeles have been one-way streets since 1947 and the merchants have accepted the plan with the passing of time.

Raleigh, North Carolina (Pop. 71,300), Police Department...One of our largest retail stores had its manager appear before the city council in 1950. The manager stated that if the street in front of his business was made one-way, it would put him out of business. Three years after this street was made one-way his floor space and frontage and volume of sales was twice as good. Not a single establishment in our one-way streets has gone out of business as a result of the one-way regulation.

Ypsilanti, Michigan (Pop. 19,500), Board of Commerce...Property values have actually been enhanced judging from the leases that have been signed on the streets and the complete lack of any vacancies.

"DO ONE-WAY STREETS EVER HURT BUSINESS?"

In some cases individual businesses may suffer because traffic flow from one direction past their location is cut off. Usually such effect is temporary. These occurrences involve principally those industries that cater to traffic from a particular direction and include parking lots or garages, food stores, service stations, and drive-in establishments. In some cases, too, public transit companies have reported ill effects from one-way operation.

Only seven (five per cent) of the 134 cities in the U.S. Chamber survey reported any real hardships to business houses and these involved only a few cases in each city. A survey of 50 cities made by Robert Dier, City Traffic Engineer of Fresno, California, in 1949, showed merchants associations opposed to one-way streets in ten per cent of the cities, four per cent because they believed them to be harmful to business.

The following are typical comments in the Chamber survey on this question:

Eugene, Oregon (Pop. 39,900), Chamber of Commerce...There are a few instances where specific intangible damage occurred to the business volumes within the Eugene downtown one-way grid pattern. One or two service stations, for example, gave up their corners but they transferred their operations to new traffic volume corners to their ultimate benefit.

Hoboken, New Jersey (Pop. 50,400), Chamber of Commerce...It is my observation that small businesses suffer on avenues in New York City which have recently been made one-way. While those avenues take approximately six lanes of traffic it is dangerous to cross lanes to draw near a business entrance. The traffic has been speeded up and this, too, reduces the opportunity to stop for a transaction.

Indianapolis (Pop. 429,500), Chamber of Commerce...The experiences of long lines of cars moving in short hitches out of the downtown district in the evening rush hour no longer exists..The filling station operator who was most vociferous in opposition before the change has not mentioned the subject to me since that time. I am told by some realtors that they have checked with some filling station operators who admit their business has come back. They said they lost some customers with the change but got new ones or old ones returned and their volume is as high as before. I'd guess it is in many instances higher, as a great deal more traffic is moved on these streets than formerly.

Kansas City, Missouri, (Pop. 476,100), Chamber of Commerce... We cannot prove that the one-way streets are bringing more customers to the stores. However, we do know that it has not decreased sales except in a few remote cases where a specialty shop or drug store had a bus loading zone in front of the building and which subsequently was changed because of the one-way flow of traffic, making it necessary to eliminate this loading zone. Also, several parking stations lost business because it was necessary to circle a block in order to reach this lot. There happened to be lots closer and naturally the driver would take the first one. Of course, where it hurt some businesses as just mentioned, it did help others...90 per cent of our downtown business people and a large percentage of the motorists driving in the downtown district believes the one-way plan is a great improvement for our situation.

Newark, Ohio (Pop. 35,900), Chamber of Commerce...Previously, two grocery stores on Church Street did considerable business during this peak period due to the number of people who were westbound stopping to pickup groceries on their way. These stores showed heavy spurts in volume during these peak hours. Now, with all traffic eastbound on this street, these stores do not have this heavy peak volume, but actually, according to their reports, their business is better and is spread out more evenly throughout the day. So while both of these merchants objected to the one-way plan prior to its trial, they now are very well pleased with it and have dropped their objection.

New York City Omnibus Corporation...Where one-way avenues have been established, for example on First and Second Avenues, access to bus lines has been made extremely difficult for residents living east of First Avenue who wish, for example, to go southbound in the A.M. rush hour. To get a bus requires a walk of approximately 1,900 feet...As a result of the establishment of one-way operation on Ninth and Amsterdam Avenues, bus operation on that route, because of the extreme drop in passengers, is now carried on at a very substantial financial loss.

Another, more recent reference regarding the general benefits to be derived from one-way streets, is included in a recent publication on the Program for Highway Safety by the President's Committee for Traffic Safety:[2]

> "Much evidence shows that one-way streets, properly engineered, are beneficial to vehicles and pedestrians alike.

(2) "Engineering - A Section of the Action Program for Highway Safety", Report of the President's Committee for Traffic Safety, Supt. of Documents, U.S. Govt. Printing Office, Washington 25, D.C., 1961.

"In a western city, for example, a 62 per cent reduction in pedestrian accidents was reported after 19 streets were converted to one-way operation. One-way operation increases street capacity, hence permits higher traffic volumes and speeds.

"Following are a few examples in cities of varying size:"

CITY	1960 POPULATION	SCOPE OF ONE-WAY SYSTEM	RESULT		
			Volume Increase	Travel-Time Decr.	Accident Reduction
New York City	7,660,000	75 per cent of streets in Manhattan	20%	35%	25%
Portland, Oregon	370,000	280-block business area	5-10	40-50	48
Wichita, Kansas	254,000	9 streets through central business district	150	30	30 or more
Raleigh, N.C.	93,000	7 downtown and several outlying streets.	50	48	50
Eugene, Oregon	50,000	64-block business area	10-80	20-50	"Reduced"
Modesto, California	36,000	8 streets, total length, 5 miles	24	50	28

APPENDIX

Table A-3

Anticipated Future Traffic Generation
Trenton CBD

Center City South Urban Renewal Project

Type of Development Planned:

Retail, Office, Public Park
with sufficient parking supply

Intensity of Development:

1. Maximum of 420,000 sq. ft. of retail commercial area (200,000 sq. ft. now existing).
2. Maximum of 80,000 sq. ft. of office facilities.
3. Park and Recreation area suitable for passive types of recreation use.

ANTICIPATED TRAFFIC VOLUMES*

PERIOD	NUMBER OF VEHICLES ENTERING	NUMBER OF VEHICLES EXITING
All Day	[illegible]	[illegible]
Peak Highway Hour (4:30-5:30 P.M.)		

[illegible] Field Way [illegible]

Type of Development Planned:

Residential

Intensity of Development:

1,063 Dwelling units.

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* 200,000 sq. ft. of retail now existing [illegible] in these volumes.

ANTICIPATED TRAFFIC VOLUMES

PERIOD	NUMBER OF VEHICLES ENTERING	EXITING
All Day	2,100	2,100
Peak Highway Hour (4:30-5:30 P.M.)	400	250

Mercer Jackson Project

Type of Development Planned:

Residential

Intensity of Development:

Revitalization and Restoration of existing neighborhood.

Anticipated Traffic Volumes:

No new additional traffic volumes.

Trenton Mall Properties

Type of Development Planning:

Variable:

According to economic report prepared by Gladstone Associates, an office-type component stands the best chance of implementation.

Intensity of Development:

1. 300,000-350,000 sq. ft. of office space by 1975.

ANTICIPATED TRAFFIC VOLUMES

PERIOD	NUMBER OF VEHICLES ENTERING	EXITING
All Day	750	750
Peak Highway Hour (4:30-5:30 P.M.)	50	500

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